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Tulsa Tornado Tribune

"Where People Who Know The Weather Get Their Weather"

National Weather Service Tulsa, Oklahoma

Summer, 2005

Severe Season in Review

Tornadoes were few, but hail and wind caused their fair share of significant damage

Tree damage near Sallisaw, OK April 5. Note the large fallen tree on the left side of the picture lying in one direction, while another nearby fallen tree (inset) lies in the opposite direction. This type of pattern indicates tornado damage as opposed to straight-line wind damage.

Although the spring of 2005 was a relatively quiet one in terms of severe weather, there were a few events of note. One such event took place on the afternoon and evening of April 5th, when a potent upper level low pressure system moved out of the southwest toward the southern plains, setting up a classic severe weather pattern for Oklahoma and Arkansas.

Severe thunderstorms developed along a dry line over central Oklahoma by early afternoon, moving across eastern Oklahoma from mid afternoon through early evening. There were numerous large hail reports, along with three confirmed tornadoes and several reports of straight-line wind damage in southeast Oklahoma. The storms gradually moved east into northwest and west central Arkansas later in the evening, with several large hail reports coming in before the storms eventually weakened below severe limits.

The early round of storms produced penny to quarter sized hail to the west of Tulsa between 3 pm and 4:30 pm. There were also reports of significant wind damage in Okfuskee County, where winds estimated at 70 mph caused roof damage to three homes west of Castle,

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Zero Tornadoes in May

For the first time since official records began in 1950, no tornadoes were reported in the state of Oklahoma in the month of May. This is based on preliminary data and is subject to change before the records become official. In addition, no tornadoes were reported in the Arkansas portion of NWS Tulsa's forecast area.

One report of a possible tornado was received by the Tulsa office near Brushy Lake in Sequoyah County, Oklahoma, on May 24. However, a damage survey conducted by the NWS in Tulsa found no conclusive evidence of a tornado.

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Editor's Note

Now that summer is almost over, welcome to the summer edition of the Tulsa Tornado tribune. The main story this summer has been dry weather, although the last couple of weeks have seen some improvement.

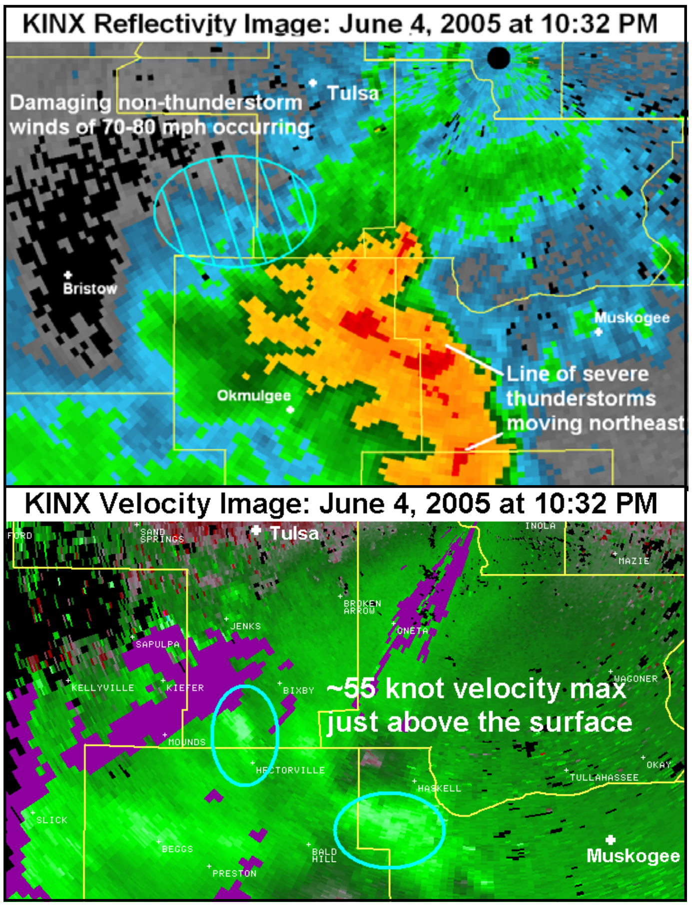
If there is anything you would like to see more or less of in future newsletters, please don't hesitate to let us know.

Craig A. Sullivan - Editor

Inside this issue:

Heat Bursts

During the late evening hours of June 4, a line of severe thunderstorms tracked from southeast Oklahoma through northwest Arkansas, producing a swath of 60 to 75 mph wind gusts and considerable damage. As forecasters at the NWS in Tulsa were monitoring these storms, reports of high winds began to come in from spotters south of the Tulsa metro area between 10 pm and 11 pm…but the line of storms remained well to the south. So, what was causing these strong winds far away from any radar echoes? The answer is a phenomenon known as a heat burst.



Reflectivity and Velocity images from the Tulsa Radar on the evening of June 4. There are two distinct velocity signatures (blue circles); one along the leading edge of the line of storms, and another more subtle signature on the northwest flank. Both were associated with damaging wind gusts of 60-70 mph at the time.

A heat burst is a downdraft of relatively hot and dry air, usually during the decaying phase of a thunderstorm, and most often in the evening or overnight hours. Heat bursts usually develop when a layer of dry air is present in the upper levels of the atmosphere. Precipitation falling from the highest levels of the storm into the dry air will cause the air to cool due to evaporative processes, becoming denser than the surrounding environment. This causes a downward acceleration of the air parcel toward the surface.

However, as the air parcel descends toward the ground, it warms rapidly due to compression, making it warmer and less dense than the surrounding environment. Air parcels that are warmer than the surrounding environment have a tendency to rise, so in order for the parcel to actually reach the ground, it must have enough downward momentum to overcome this tendency. This may, in fact, be the reason heat bursts are a relatively rare phenomenon.

The process is somewhat like a microburst, except the origin of a microburst is normally in the lower to mid levels of the atmosphere. Thus, there is not as much compressional warming in a microburst, and they are accompanied by cooling temperatures at the surface. Also, microbursts in this part of the country are often accompanied by heavy precipitation, whereas heat bursts are almost always dry.

Time	Temp (°F)	Dew Point (°F)	Wind
9 PM	81.0	71.1	S 12 mph
10 PM	79.0	71.1	SSE 21 mph
11 PM	81.0	66.0	S 37G49 mph
12 AM	78.1	54.0	SSE 27G39 mph

Hourly observations at Tulsa International Airport June 4.

The intensity of a heat burst depends on the size of the collapsing storm and how much the air can warm before reaching the ground. While the June 4 heat burst showed only a modest rise in temperature, the dew points dropped considerably, and wind speeds of 70 to 80 mph were common in the Tulsa area, as well as in Mayes, Ottawa and Adair counties. Needless to say, there was considerable damage associated with the heat burst in the form of downed trees and power lines. Some 40,000 homes in the Tulsa area lost power.

While heat bursts seem to be a relatively "new" occurrence, they have been documented as far back as the early 20th century. In reality, these events tend to be short-lived and localized, making it difficult to sample them with sparse observation networks. Improved observation networks, such as the Oklahoma Mesonet, take more frequent observations from a denser network of sites, increasing the number of documented cases in recent years.

Weather History - Summer of 1980

Twenty-five years ago, residents of the southern and central United States, including Oklahoma and Arkansas, suffered through one of the hottest summers on record; the infamous summer of 1980. When all was said and done, this disastrous heat wave had become one of the costliest weather disasters of the 20th century, both in terms of monetary and human loss.

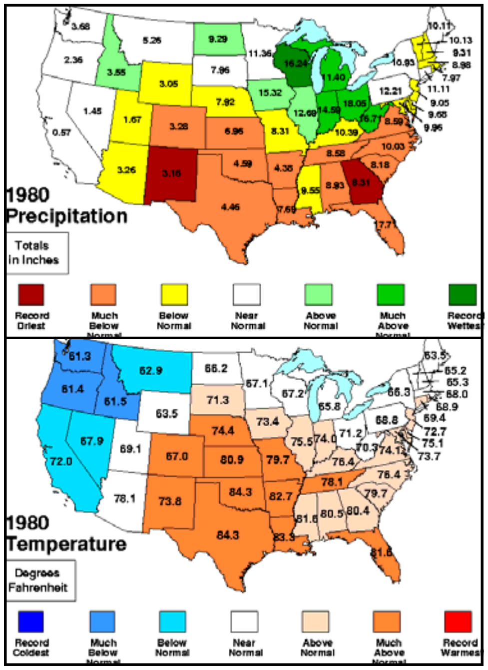
The setup

The weather pattern that led to the heat wave was not unusual…what was unusual was the longevity and intensity. Normally by late June to early July, a large subtropical high pressure ridge becomes established over the southern states, and persists into early September. When this happens, weather systems are kept to the north for the most part, and we are left in the all-too-familiar pattern of hot and muggy days, with infrequent (though sometimes intense) rainfall. Variations in the pattern can lead to some unusual summers (2004 comes to mind due to the *lack of* this persistent feature), and this was certainly the case in 1980.

By early June, there were already signs that summer was about to take hold. Temperatures during the first week of June were well above normal, before a brief respite occurred during the middle of the month. Almost 5 inches of rain fell in Tulsa on the 16th and 17th, but it would be nearly two months before significant rain would fall again. By June 23rd, the heat was on for good, with temperatures soaring into the triple digits by the 25th. The summer heat wave of 1980 was underway.

Shattering Records

As July droned on, it was clear that this was going to be a historic summer in terms of heat and drought. The unrelenting high pressure ridge simply would not budge, leading to an incredible string of hot and rainless days. The high temperature in Tulsa topped the century mark each of the fist 21 days of July. Perhaps even more remarkable



Map of temperature and precipitation anomalies for the Summer (June-August) of 1980. The "much above/below normal" category represents a ranking in the top/bottom 10 of all time.

was the fact the overnight lows failed to drop below 80 degrees during the fist 20 days of the month. The heat reached its pinnacle on the 16th, when Tulsa recorded a "low" of 87 degrees, still to this day the warmest low temperature *ever* at Tulsa, and a high of 109. Only one other day in recorded history had a higher daily average temperature than the 98 degrees posted that day.

Some areas caught a mini-break on the 23rd, with a low of 63 and a high of "only" 97 degrees in Tulsa, making that the only day the average temperature was below normal. A few locations saw showers during the month, but significant rain was hard to come by. Water rationing was becoming the norm across the area as a result.

The heat returned strong as ever for the last few days of July, and when the final statistics were compiled, Tulsa had suffered through its hottest month on record. The mercury toped 100 degrees 26 times, and the average high for the month was a whopping 103.4. Statewide, it tied for the hottest July on record in Arkansas, and was second hottest for Oklahoma.

A brief respite

August started a lot like July…HOT…with no end in sight. The high in Tulsa reached 109 on the 2nd, and highs broke 100 for the first 20 days of the month. By mid month, however, a bit of a change in the upper level pattern began to take shape, as the ridge shifted more over the southeastern United States.

The pattern shift allowed a weak disturbance to bring the first significant rains to the area in several weeks on the 17th. Some areas north and west of Tulsa received over an inch of rain, a welcome sight indeed for area residents. Tulsa finally received some desperately needed rain a few days later, followed by a seemingly cool high temperature of 93 on the 22nd ("coolest" since June 22nd). Alas, this was not the end, as temperatures soared once again at month's end.

This too shall pass

The high in Tulsa reached 100 on

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1980

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September 1, marking the 57th day of triple-digit heat. By the next day though, a significant change occurred as 2.5 inches of rain fell, and the high temperature reached a mere 80 degrees. Could this finally be the end? Well, not quite. The next two weeks saw temperatures back above normal, but not to the same degree as was seen in July and August.

By the last week of September, the relentless heat finally broke for good, with rain and temperatures in the 60s and 70s. Fall had finally won out.

Historical significance

Statistically, the summer of 1980 was not *the* hottest and driest on record, but definitely near the top. In terms of statewide seasonal average temperature for both Arkansas and Oklahoma, hotter summers occurred in both states in 1934, in Oklahoma in 1936, and in Arkansas in 1954. Precipitation statistics were equally bleak as both states saw the third driest summer ever. Only 1954 and 1936 were drier in Oklahoma; 1930 and 1954 were drier in Arkansas.

Most of the southern and central U.S. were affected by the drought. Estimates from the National Climatic Data Center show about 20 billion dollars (48 billion when normalized to 2002 dollars) in agricultural losses resulted from this heat wave. Only the drought and heat wave from the summer of 1988, which affected a much broader area, has resulted in higher monetary losses since. While the official death toll is listed at around 1700, some studies have suggested that as many as 10,000 deaths could be attributed to the heat during the summer of 1980.

Several records set in 1980 still stand today. While only four daily maximum temperature records still stand at Tulsa, an amazing 35 record high minimums are still in the books, along with 25 high daily mean temperatures. One interesting footnote to the temperature statistics: 1980 is officially listed as the hottest summer (Jun-Aug) in Tulsa history. However, at the time, the official thermometer at Tulsa International Airport was in a different location, and was likely impacted more by the concrete and asphalt. Local studies have shown that the official temperature readings for Tulsa may have been as much as a degree and a half higher before the site was relocated in 1991. While this does not take away from the overall significance of this event, one should take this into account when comparing with temperatures in more recent years.

Heat Safety

Here are some precautions you can take to lessen the effects of summer heat…

- Increase intake of non-alcoholic and non-carbonated beverages; e.g. water and juice.
- Wear light colored, loose fitting clothing.
- If possible, avoid the outdoors during the hottest time of day, and limit strenuous activities to the cooler parts of the day.
- Check on the elderly; they are especially susceptible to heat related illnesses.

Did You Know?…

- The value of heat index is based on shady, light wind conditions. Exposure to direct sunlight can add as much as **15 degrees**!
- Studies have shown the temperature inside an enclosed vehicle may rise nearly 20 degrees in 10 minutes, and 45 degrees in one hour!
- In an average year, nearly 200 Americans succumb to heat-related illnesses.

HEAT INDEX (°F)

	RELATIVE HUMIDITY (%)												
Temp	40	45	50	55	60	65	70	75	80	85	90	95	100
110	136												
108	130	137											
106	124	130	137										
104	119	124	131	137									
102	114	119	124	130	137								
100	109	114	118	124	129	136							
98	105	109	113	117	123	128	134						
96	101	104	108	112	116	121	126	132					
94	97	100	103	106	110	114	119	124	129	135			
92	94	96	99	101	105	108	112	116	121	126	131		
90	91	93	95	97	100	103	106	109	113	117	122	127	132
88	88	89	91	93	95	98	100	103	106	110	113	117	121
86	85	87	88	89	91	93	95	97	100	102	105	108	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

Category	Heat Index	Possible heat disorders
Extreme Danger	≥ 130	Heat stroke and/or sunstroke likely.
Danger	105-129	Muscle cramps and/or heat exhaustion likely; Heat stroke possible.
Extreme Caution	90-105	Muscle cramps and/or heat exhaustion possible.
Caution	80-90	Fatigue possible.

Flood Stage Change

On June 28, the National Weather Service in Tulsa changed the flood stage for the river forecast point on Lee Creek near Van Buren, Arkansas from 23 feet to 401 feet. This change appears more drastic than it really is. The new flood stage is based on the height above mean sea level. The previous flood stage was based on measured water elevation above a preset level.

The new flood stage is based on the water level below the dam just northwest of Van Buren. This tailwater measurement will provide a more realistic assessment of flood potential downstream of the dam and more accurately measure the influence of backwater from the nearby Arkansas River. Flooding is more likely on Lee Creek downstream from the dam whenever the Arkansas River is also high.

The new tailwater measurements at the Lee Creek Dam will be provided by the city of Fort Smith. This change in flood stage has been coordinated with the U.S. Army Corps of Engineers, U.S. Geological Survey, the Crawford County Emergency Management Agency, the city of Van Buren and the city of Fort Smith.

There will be no change in the NWS forecast and warning services for those impacted by Lee Creek downstream from the Lee Creek Dam site. However, people affected will need to know the new flood stage. For a time, it may be difficult to relate forecasted tailwater heights to past events. With time, though, the change should provide affected users with a better forecast. As always, public feedback is welcome regarding this change.

Local News

Awards Given

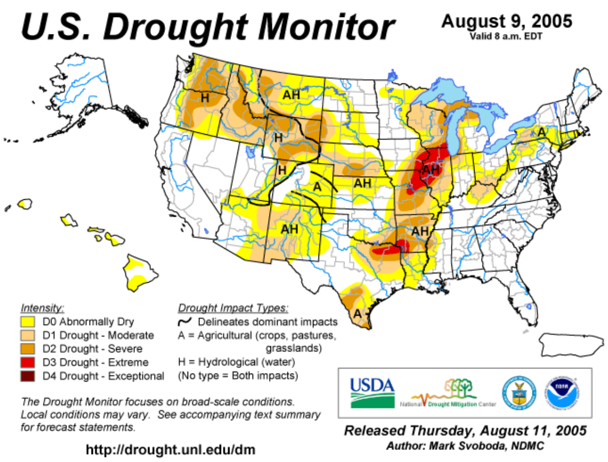
Chuck Hodges, Brad McGavock, Jamie Frederick and Ray Sondag of NWS Tulsa recently received NWS Director's Awards for the development and implementation of the Decision Support Page for the NWS Tulsa website. Also, WFO Fort Smith Liaison Officer Forrest Johns received a Director's Award for outstanding teamwork. Congratulations to all!

Employee Milestone

Data Acquisition Program Manager Mike Teague was recently recognized for 30 years of federal service. Congratulations Mike, and the people of America thank you!

Developing Drought

Recent precipitation deficits across the region have led to a developing drought over portions of Oklahoma and Arkansas. Especially troubling was the month of May, which is typically the wettest month of the year. Oklahoma as a whole experienced it's second driest May on record.



Oklahoma Climatological Survey data indicates precipitation from March 1 to August 1 ranged from about 50 percent of normal in southeast Oklahoma to 66 percent of normal in northeast Oklahoma. Year-to-date precipitation totals for western Arkansas were about 75 percent of normal.

The Palmer drought severity index map issued by the Climate Prediction Center on August 6th shows severe drought conditions across east central and southeast Oklahoma as well as west central Arkansas. Moderate drought conditions are depicted in northeast Oklahoma and northwest Arkansas.

According to the U.S. Geological Survey, streamflows are near to slightly below normal for much of the Arkansas River basin. Rainfall has been heavier this warm season in the upper portions of the Arkansas basin. However, streamflows are well below normal for much of the Red River basin which drains a large part of southeast Oklahoma.

Soil moisture conditions remain well below normal. Most major reservoirs are within 10 percent of their normal levels. However, Eufaula, Grand and Tenkiller are each down around 80 percent of normal. In northwest Arkansas, Beaver Lake is down around 75 percent of its normal pool.

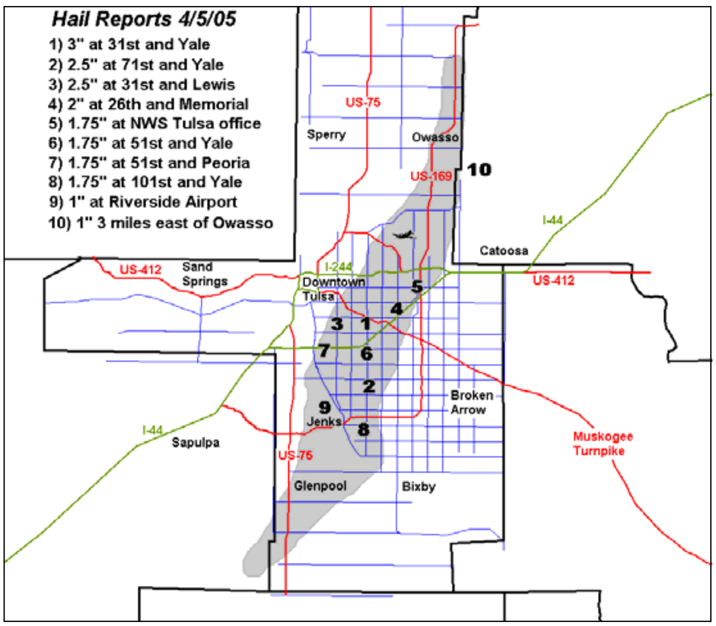
On the 90-day outlook for August through October, temperatures have a slightly greater chance to be above normal, with an equal chance for precipitation to be below, near, or above normal. The next hydrologic outlook statement for the drought conditions will be issued on August 24.

Severe Season

(Continued from page 1)

and blew a sheet metal roof off a barn 1 mile east of Mason.

As these storms moved through the Tulsa metropolitan area around 4:30 pm, they intensified and produced a swath of significant hail damage through the city's midtown section (see map below). Golfball to baseball sized hail caused considerable roof and car damage throughout the city, with a total preliminary damage figure of 65 million dollars. The storms continued to produce large hail to the north and east of Tulsa over the next couple of hours.



Hail reports received by the National Weather Service the afternoon of April 5 in the Tulsa metro area.

Additional storms moved into southeast Oklahoma by around 6 pm, and produced what proved to be the most significant tornado "outbreak" of the season (albeit a meager one by our standards). One tornado struck about 2 miles west of Red Oak in Latimer County, while a second tornado touched down 3 miles north of Red Oak a short time later. Both were rated F0, with damage limited to snapped and uprooted trees.

A third, more significant tornado struck in western Sequoyah County. The tornado snapped and uprooted numerous large trees, and caused significant damage to several metal barns along its 2.5 mile path near Sallisaw. The tornado was rated F1. Straight line wind damage, likely associated with the storm's rear flank downdraft, was noted from just north of Robert S. Kerr Reservoir northeastward through Sallisaw. Numerous trees were uprooted and several barns and storage facilities sustained major damage.

Other reports of straight-line wind damage came in from southeast Oklahoma during the evening. Wind gusts estimated at 80 mph damaged outbuildings in Haskell County near Kinta. Considerable wind damage was reported in Pushmataha County, where 80 mph winds severely damaged a garage and a 30 foot section of a lumber storage building near Nashoba.

Only one other tornado was spotted in April, when a very brief touchdown was reported 3 miles southwest of Inola, OK, on the 21st. The same supercell produced softball size hail in Tiawah. Significant wind damage was reported in Haskell and LeFlore counties in eastern Oklahoma that same evening.

May, normally the peak of severe weather season, was unusually quiet with no tornadoes reported (see **Zero Tornadoes** on page 1). Most of the reported severe weather was in the form of straight-line wind damage. Winds estimated at 70 mph caused damage at Blue Ribbon Downs in Sallisaw, OK, on the 13th. A swath of damaging winds occurred across northeast Oklahoma into northwest Arkansas on the 23rd, with many locations reporting tree damage. The next morning, heavy rains caused significant flooding in the city of Tahlequah, OK, where four people were rescued after their car stalled at a low water crossing.

The first half of June was considerably more active. A round of storms on the 4th produced two tornadoes; one near McCord, OK, and another 6 miles northeast of Wagoner, OK. The same evening, there were numerous wind damage reports across eastern Oklahoma into northwest Arkansas (see **Heat Bursts** on page 2). There were other significant wind events on the 12th, 13th and 16th, before the severe season wound down, almost right on cue.

Zero

(Continued from page 1)

Prior to this year, the record lowest number of May tornadoes was two, in 1988. Until this year, May was the only month of the year that always had at least one tornado confirmed in Oklahoma. Based on preliminary data through May, there were 15 tornadoes in Oklahoma, well below the average of 36 for January through May.

The rest of the nation also saw below average tornado numbers this spring. For the first time since reliable statistics began, there were no tornado fatalities in the United States in April through June. Also, the nationwide January through May tornado total was the lowest in 20 years.